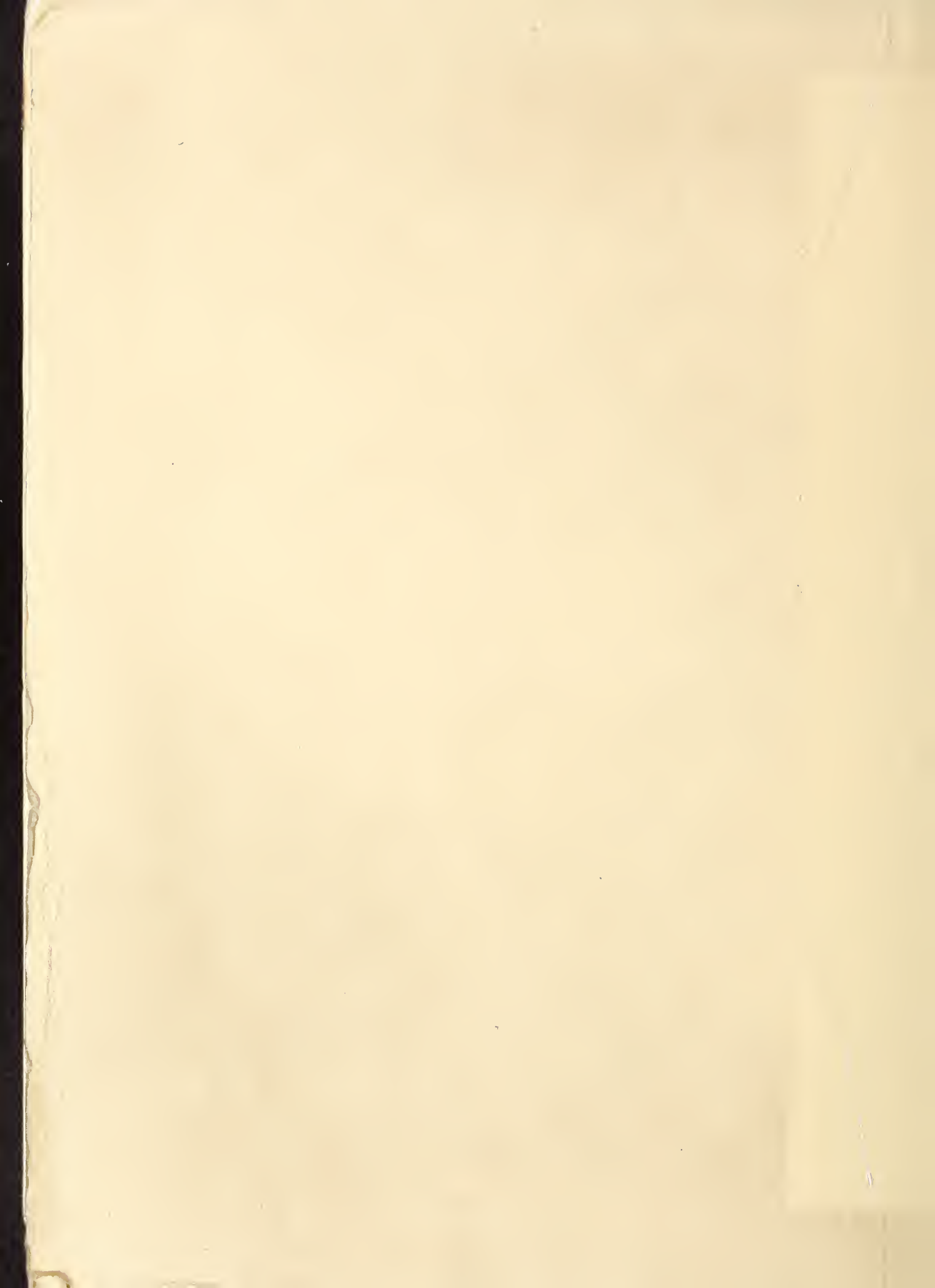


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Paper and Cotton Shipping Bags for Kern County Potatoes ^{1/}~~CONFIDENTIAL~~W. R. Barger ^{2/}, L. L. Morris ^{3/}, andG. B. Ramsey ^{4/}

In 1942 the diminishing supply of burlap bags for agricultural use due to the war forced potato shippers to look for suitable substitute containers for their crop. Cotton bags were made available for potatoes and in some districts paper bags were used. In Kern County, California, the substitutes being used quite extensively included tub baskets and bags made of cotton sheeting and mesh.

One of the first considerations in choosing a substitute for burlap bags is the utilization of the present bag-filling equipment, whether or not the substitute container can be filled in the same manner and as easily and quickly as the burlap bag and, if not, whether there is suitable filling equipment available. A second requirement is that the container should withstand commercial handling and shipment, and a third point is its suitability as a package for the shipment and market display of potatoes.

Kern County supplies about half the nation's early potatoes during April, May, and June. Each packing house unit is geared to wash, pack in 100-pound bags, and load about a carload of freshly dug potatoes an hour. If this speed were not maintained, loss might result from prolonging the season into the hot weather.

Although early potatoes have been shipped commercially from some eastern states in tub baskets and wire-bound veneer boxes of about 50-pound capacity and in consumer-size paper bags of 10-, 15-, and 25-pound capacity, in Kern County the standard unit for potatoes has always been the 100-pound burlap bag and the packing house equipment has been designed to handle either this size or the 50-pound bag. Small containers increase the cost of packing and loading but some markets have been willing to pay the additional cost of 10 cents per hundredweight for packing in 50-pound bags. Consumer-size cartons have been tried in the past and have been abandoned largely because reimbursement for the extra cost could not be obtained in competition with the 100-pound bag. In the case of the shipments in baskets this year most buyers would not pay for the increased cost of packaging and preferred the 100-pound bag.

^{1/} Part of a cooperative investigation of methods of handling and shipping truck crops conducted by the U. S. Department of Agriculture and the California Agricultural Experiment Station.

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The Kern County early potato crop is predominantly of the White Rose variety. Digging may start before the skin is thoroughly set and the potatoes usually become skinned or feathered during digging and handling. Such skin injuries on this variety readily brown from exposure to wind, sun, or very dry air. After washing, the tubers drain somewhat on the grading belt but are packed before they are thoroughly dry. The hot, dry weather that usually prevails during potato harvest in Kern County desiccates the skinned portion of the tubers and often causes objectionable browning of the surface in transit. The dry air likewise prevents normal development of new skin, and this predisposes the skinned areas to bacterial growth and resultant stickiness or sliminess.

With these conditions in mind, several shipping tests and holding tests were made with Kern County potatoes during May and June, 1942, comparing bags made of paper, cotton sheeting, cotton mesh, and burlap-- particular attention being given to the carrying quality of the potatoes in the various containers. The shipments and their condition upon arrival are summarized in table 1.

Tests with paper bags

Railroad shipments were made in which ten to seventy 50- or 100-pound paper bags were included as a part of 36,000-pound commercial loads of cotton or burlap bags. The bags were made of 4-ply kraft paper and were closed with twisted wire ties. Some of the bags were perforated with twenty-four quarter-inch holes to provide ventilation. Considerable difficulty was experienced in filling the bags because they could not be hung on the jigger used for burlap bags and the tying operation was slow. However, after the bags were filled with wet potatoes they did not become soaked through and withstood the necessary trucking and handling during loading.

The first test car, loaded May 21, 1942, was shipped to Dallas, Texas. The load was of the pyramid type and contained about sixty 100-pound paper bags in two double stacks 6 layers high, with the remainder of the load made up of 100-pound burlap bags. The stock was slightly skinned but was not wind injured (desiccated). The potatoes arrived in very good condition. There was no evidence of heating in either the ventilated or the nonventilated paper bags and there was somewhat less bruising in the paper bags than in the burlap bags. However, approximately one-half the paper bags showed some worn and torn places and many had opened at the seam apparently because of moisture absorbed enroute.

The second test car was shipped to Portland, Oregon, May 23. It contained about seventy 50-pound paper bags as part of a 720-bag load of 50-pound burlap bags. The paper bags adjacent to the walls were laid crosswise of the car with the ties toward the wall and those in the central section were laid lengthwise making a load nine rows wide and 5 and 6 layers high. The potatoes and the paper bag containers both arrived in very good condition in this car. There was no evidence of heating or lack of ventilation in the paper bags. The skinned areas were lighter in color on potatoes in the paper bags than in the burlap bags and were well healed over whereas in burlap bags the skinned areas developed a dark crust with numerous small spots where bacteria had begun to invade the dead outer tissue. There was less shrinkage of the potatoes in paper than in burlap bags; averages of twenty-bag lots showed 1-3/4 pound loss in weight per bag in burlap and one pound in paper. The potatoes in paper bags also showed less bruising than those in burlap bags.

In other cars in which paper bags were used for shipping to eastern markets (Chicago, Illinois; Milwaukee, Wisconsin; and Logansport, Indiana) results similar to those in tests 1 and 2 were obtained in all but one test. In one car several

bags of skinned and wind-injured potatoes were shipped to Chicago, June 20, under standard ventilation. The potatoes in paper bags developed 53 per cent decay as compared to 34 per cent in burlap. The inspection report states that most of the decay was bacterial soft rot evidenced by a sticky, slightly moist surface. In the more advanced stages there was some slime and occasionally *Fusarium* and *Penicillium* growing over the surface. Browning of the skinned areas occurred on 26 per cent of the potatoes in paper bags and on 30 per cent in burlap bags.

Holding tests in which potatoes were stored at Fresno under conditions of time and temperature similar to those in cars moving to eastern markets showed that under both sets of conditions the effect of the container on the produce was about the same. During storage for one week moisture loss at 70° F and 50 per cent relative humidity was the same in vented and nonvented paper bags as that in burlap, amounting to about $4\frac{1}{2}$ per cent, whereas at 50° F and 80 per cent relative humidity the loss was about $1\frac{1}{2}$ per cent in paper bags and 2 per cent in burlap bags. Potatoes from both storage conditions lost about 1 per cent in weight during the first two days after removal to store temperature of about 80° F. There was less browning in the paper than in burlap bags and also better healing over of skinned areas. There was no internal darkening (black heart) caused by suffocation. During five days' holding in diffused light after storage, no greening occurred in paper bags whereas slight greening occurred in burlap bags.

Analyses of the atmosphere inside the nonvented paper bags during storage showed no accumulation of carbon dioxide or depletion of oxygen such as occurs when potatoes are held in air-tight containers. This indicated that the paper was sufficiently porous to permit adequate diffusion of oxygen to and carbon dioxide away from the tubers. Porosity measurements of the paper also indicated this. These measurements also showed that when the paper is moist, as it would be under commercial conditions, its porosity to air movement increases, but when it is very wet complete sealing occurs. The effect of paper thickness (number of plies) on porosity was also determined. It was found that after a thickness of 4 or 5 plies is reached, additional plies have relatively little effect upon the rate of air movement.

In all these tests, potatoes that were not wind-injured carried well in paper bags, but whenever the 100-pound bags were used there was an objectionable amount of bag failure necessitating resacking at the market. The 50-pound paper bag stood up very well under shipping.

Tests with cotton sheeting and cotton mesh bags

In several of the test cars, cotton sheeting, cotton mesh (Victory cloth), and burlap bags were compared. Fabric bags, regardless of the material, present no serious mechanical problem in the packing house because they can be filled and sowed like burlap. Cotton bags proved to be a very successful substitute for burlap. They were available in quantities needed, and with the exception of a couple of instances where the bags were made longer and narrower than usual and of lightweight sheeting, they carried the potatoes with only slightly more transit bruising than did burlap bags. The narrow 100-pound bag which measured 20" x 42" had to be loaded with the two wall-rows laid across the car and two center rows laid lengthwise, thus necessitating extra handling and increasing the possibility of rough handling during loading. When this bag was made of lightweight sheeting it frequently buckled and tore during handling. The medium-weight bag measuring about 23" x 36", similar in size to many burlap potato bags, made a strong, compact unit which could be loaded by any of the customary methods.



The first part of the document is a letter from the Secretary of the Board of Education to the President of the Board of Trustees. The letter is dated January 1, 1891, and is addressed to the President of the Board of Trustees of the University of the State of New York. The letter discusses the progress of the Board of Education during the past year and the plans for the future. It mentions the work of the various committees and the progress of the various projects. The letter is signed by the Secretary of the Board of Education, John W. Aldrich.

The second part of the document is a report of the Board of Education for the year 1890-1891. The report is dated January 1, 1891, and is addressed to the President of the Board of Trustees. The report discusses the work of the Board of Education during the past year and the plans for the future. It mentions the work of the various committees and the progress of the various projects. The report is signed by the Secretary of the Board of Education, John W. Aldrich.

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REPORT OF THE BOARD OF EDUCATION FOR THE YEAR 1890-1891

The Board of Education has the honor to acknowledge the receipt of the report of the Board of Trustees for the year 1890-1891. The report is a valuable document which contains a full and complete statement of the work of the Board of Trustees during the past year. The Board of Education is deeply indebted to the Board of Trustees for the many valuable suggestions and recommendations which have been made during the past year. The Board of Education is confident that the suggestions and recommendations of the Board of Trustees will be of great value to the Board of Education in the future.

The Board of Education is also deeply indebted to the many teachers and students who have made the past year so successful. The Board of Education is confident that the suggestions and recommendations of the Board of Trustees will be of great value to the Board of Education in the future.

In test shipments with cotton, fine mesh, and burlap bags, there was excessive bruising of potatoes in 42" lightweight cotton bags, slight bruising in 36" medium-weight cotton bags, and slight bag marking in 36" fine-mesh bags when compared with fairly heavy 36" burlap bags. Shrinkage was greater in fine-mesh bags than in cotton sheeting or burlap, and slightly less in cotton sheeting than in burlap. Browning was greatest in mesh bags and severe browning was slightly less in cotton sheeting than in burlap. After unloading at the market, greening developed readily in the fine-mesh bags, and developed slightly sooner in cotton sheeting bags than in burlap. Holding tests at Fresno confirmed these results.

Practical considerations

The investigations on the shipment of White Rose potatoes from Kern County in various types of bags has shown that paper bags can be used under certain conditions. Sound potatoes carried well in 50-pound paper bags. The relatively high humidity that occurred in paper bags as compared with that in burlap not only reduced shrinkage and browning in transit but also promoted normal development of new skin (dry air desiccates skinned areas and prevents the development of the new skin). However, the high humidity that prevailed in paper bags caused increased decay of skinned potatoes that were exposed to dry wind during digging and during hauling to the packing house. Increased decay might reasonably be expected if potatoes infected with late blight were shipped in paper bags. Under Kern County conditions, slow drying or high humidity inside the container is desirable for nonwind injured stock because it promotes healing of skinned areas. Venting did not materially change the conditions of moisture and air inside of paper bags and there was no evidence of heating or smothering of potatoes shipped in nonvented bags. At present there appears to be no reason to provide holes in the paper bags for ventilation.

The adoption of paper bags for Kern County potatoes will probably depend on the supply and cost of bags of not over 50-pound capacity and on the success with which the present bag filling equipment can be converted to handle paper and fabric bags interchangeably.

Comparing cotton fabric bags with burlap the investigation has shown that mesh bags increased shrinkage and bag marking in transit. Cotton sheeting bags proved very desirable and, although they were not quite as strong as burlap and the potatoes in them were apparently more subject to greening than were those in burlap, these objections could probably be met by proper handling during loading and at the market. Bag spotting of white cotton bags due to placing wet potatoes in them caused some confusion at the market because spotting of burlap bags has usually been associated with decay; but no doubt the trade will soon learn to differentiate between spots resulting from wetness of sound stock and those coming from decay.

The observations reported here apply to only one shipping season. Additional shipping and holding tests using various containers will be conducted if this seems desirable.

Acknowledgements

Acknowledgement is made of the cooperation of the following persons and firms in furnishing bags and providing for car-lot shipments for the tests:

W. B. Camp; J. C. Jacobsen, George Reinich, Ed Ramsay, Curtis Robinson, Safeway Stores Inc., Sill Properties Inc., DiGiorgio Farms, and Crown-Zellerbach Paper Company.

April, 1943

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

Table 1. Arrived condition of potatoes and containers of test shipments made from Kern County, California, 1942.
(All potatoes were washed, were of the White Rose variety, and were loaded 36,000 lb. per car.
Tests 1-6 refrigerated; test 7 ventilated.)

Test	Date shipped and destination	Bags compared	Condition of bags	Condition of tubers
1	5/21, Dallas, Texas	60; 100-lb. paper 300, 100-lb. burlap	Paper: many chafed, loose at seam, required resacking. Burlap: good.	Good, no evidence of "heat" in either lot.
2	5/23, Portland, Oregon	67; 50-lb. paper 653, 50-lb. burlap	Paper: good, few chafed along wall. No open seams. Burlap: good.	Paper: shrinkage less than 1 lb. per bag; firmer, brighter and no more decay than burlap. Burlap: shrinkage $1\frac{1}{2}$ -2 lbs. per bag.
3	6/3, Milwaukee, Wisconsin	11, 100-lb. paper, also single bags of burlap and of Victory mesh. Most bags in car medium cotton sheeting.	Paper bags were in doorway and arrived in good condition. Other kinds also in good condition.	Paper: less browning and slightly more decay than cloth bags. Cotton: less browning and no more decay than burlap and mesh. Cotton and paper retained dampness longer than burlap and Victory mesh.
4	6/4, Chicago, Illinois	69; 100-lb paper 45, light cotton sheeting. Remainder burlap.	Paper: some chafed on floor and along wall. Some open at seams, several burst during unloading. Cloth bags intact	This car was mostly commercial grade. 20 to 30% stick surface in all lots. Little transit bruising in paper bags; considerable in light weight cotton sheeting bags.
5	6/5, Logansport, Indiana	15, 100-lb. paper in car of light cotton sheeting bags.	Only comment from the receiver was that he did not like paper bags for potatoes.	No comment.
6	6/5, Chicago, Illinois	30, 100-lb. paper in car of light cotton sheeting bags.	No comment from receiver.	No comment.
7	6/20, Chicago, Illinois	5, 50-lb: bags (cotton sheeting, burlap, and paper) containing wind injured stock. Shipped under ventilation.		Paper: less browning but nearly twice as much decay as in burlap or cotton sheeting. Very little difference between burlap and cotton.

